

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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# MULTIMEDIA UNIVERSITY

## FINAL EXAMINATION

TRIMESTER 2, 2019/2020

### EEL3086 –SWITCHGEAR AND PROTECTION (LE)

28 FEBRUARY 2020  
09:00 A.M - 11:00 A.M.  
(2 Hours)

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#### INSTRUCTIONS TO STUDENTS

1. This question paper consists of 4 pages including cover page with 4 questions only.
2. Answer all questions. All questions carry equal marks of 25. The distribution of the marks for each question is given.
3. Please print all your answers in the Answer Booklet provided.

**Question 1**

- (a) Explain the working principal of the circuit breaker. [5 marks]  
What are the different types of circuit breakers? [3 marks]
- (b) Define ONLY FIVE of the terms below: Trip Circuit, Earth Fault, Phase Fault, Protective Scheme, Protective System, Unit Protection. [10 marks]
- (c) With the aid of diagram, explain why modern distance relays offer quadrilateral characteristics. [7 marks]

**Question 2**

- (a) Determine the time of operation of a 5A, inverse time-overcurrent relay having a current setting of 150% and a time multiplier setting of 0.4 when the circuit carries a fault current of 4000A. The relay is connected to a supply circuit through a 300/5 A current transformer. The relay characteristics are given in Table Q2(a). [12 marks]

Table Q2(a)

PSM	2	4	6	8	10	12	14	16	18
Time in Sec	7.5	6	5	4.5	4	3	2.8	2.5	2

- (b) A 50 VA, 400/5 A, 36 kV, 50 Hz current transformer (CT) is connected in a line of 14.4 kV (line-to-neutral voltage). The ammeter, relays, and connecting wires on the secondary side having a total impedance (burden) of  $1.2 \Omega$ . If the transmission line current is 280 A, calculate
- The CT secondary current [3 marks]
  - The voltage across the secondary terminals [1 mark]
  - The voltage drop across the primary [1 mark]
- (c) A 1200/5, C400 current transformer (CT) is connected on the 1000/5 tap. Secondary resistance of the standard typical excitation curve for C-Class CT is  $0.51 \Omega$ . Calculate the maximum secondary burden resistance in  $\Omega$  that can be used to maintain the rated accuracy at 20 times rated symmetrical secondary current. [8 marks]

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**Question 3**

- (a) What is Arc in a circuit breaker and how it is established? [5 marks]
- (b) A 21 kV-50 Hz, three-phase generator with earthed neutral has a reactance of  $5 \Omega$ /phase, and is connected to a bus-bar through a circuit breaker (CB). The distributed capacitance up to CB between phase and neutral is  $0.01 \mu\text{f}$ . Determine;
- The value of the peak re-striking voltage across the contacts of the CB in kV [5 marks]
  - The frequency of oscillations in kHz [3 marks]
  - The average rate of rise of re-striking voltage up to the first peak. [2 marks]
- (c) It is found that the Current transformer class C-CT ratio of 800/5 used in a circuit with its specific data written on top-left of the Figure Q3(c) may saturate. Figure Q3(c) is a typical excitation curve for IEEE class C- CT.

Design or suggest a new rate of CT value for the circuit and justify your answer, if the protection relay which is expected to operate for 5000 A at primary current is connected with the above class C-CT. Secondary CT burden is  $2.5 \Omega$ . [10 marks]

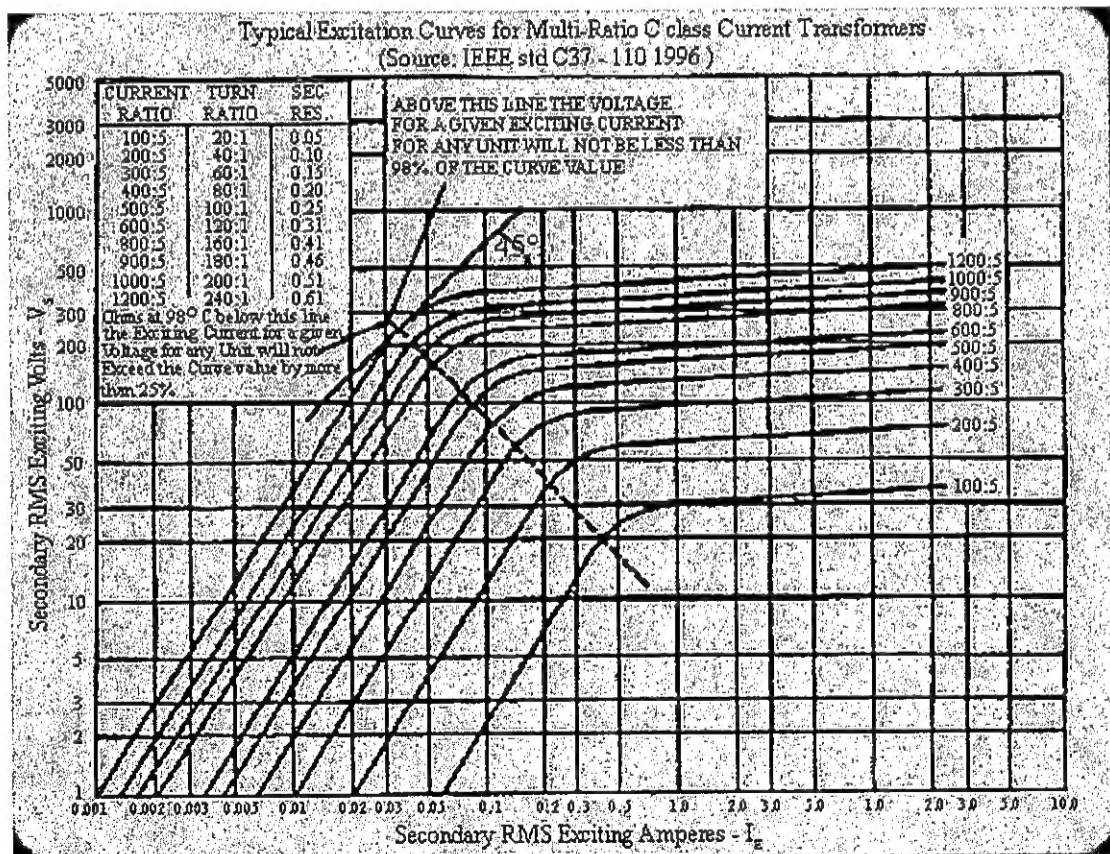


Figure Q3(c)

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**Question 4**

- (a) Explain the working of a digital protective relay? What are the advantages of a digital relay in comparison to a solid state relay? [5 marks]
- (b) List at least TEN alternator protection schemes. [10 marks]
- (c) Draw the circuit diagram of a differential protection scheme for a three-phase generator with CTs, relay, and its earthing resistance. [5 marks]
- (d) An overcurrent relay performance has been monitored over a period of one year. It was found that the relay operated 15 times, out of which 12 were correct trips. If the relay failed to issue trip decision on 4 occasions, calculate percentage of dependability, security and reliability of the relay. [5 marks]

**...End of paper**



